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Phonological awareness in children who are deaf/hard of hearing

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PHONOLOGICAL AWARENESS IN CHILDREN WHO ARE DEAF/HARD OF HEARING

by

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Abstract

This study examined the phonological awareness skills of young children who are deaf/hard of hearing through their rime identification and onset detection. The children were participants in a larger longitudinal study looking at phonological processing. The degree of their hearing losses ranged from mild to profound with both hearing aid and cochlear implant users. The participants (n=16) were asked to choose a picture from a set of four that began with (onset) or rhymed with (rime) a stimulus word. The stimulus was presented in either the auditory visual condition or auditory only condition. Their scores on these tasks were then analyzed to see if the condition that the stimulus was presented had any effect on their responses. We expected to find that the children would perform better when the tasks were presented in the auditory visual condition. This was not the case however and we found no significant relationship between the auditory and auditory visual conditions. In addition, we theorized that rime identification skills should predict onset detection skills since rhyming usually occurs first developmentally. The results agreed with this theory indicating that rime skills are a predictor of onset skills. The preliminary findings of this study promote the need for further research in this area.

Introduction

Children who are deaf/hard of hearing and communicate through oral language can be still catching up in language and speech development when their peers who are normally hearing are beginning early literacy stages. The children with hearing impairments may have oral language skills that are not as advanced as the children with typical hearing are so they may not have enough language to learn to read. Children who are deaf/hard of hearing are asked to learn to read a visual form of a language in which they are not yet proficient. Reading and language development can be reciprocal in nature just as reading and phonological awareness are beneficial to each other. Phonological awareness is accepted by many to be a reliable predictor of later reading skills (Muter, Hulme, Snowling, & Stevenson, 2004; Nathan, Stackhouse, Goulandris & Snowling, 2004). It is important therefore to examine how children who are deaf/hard of hearing progress in their emergent literacy skills such as phonological awareness so that they may possibly begin the process of learning to read at an earlier age.

Review of related literature

In the studies reviewed for this paper, all the children who participated in the research were normally hearing with the exception of Miller (2004). The study that he conducted examined children who used a manual communication method. Our study is part of greater longitudinal research that is examining children with hearing impairments who primarily use oral communication.

The acquisition of reading has been the topic of many studies over recent decades. Researchers have examined the various methodologies and approaches to reading. The written word is a visual representation of oral language. It is a skill that requires several processes and areas of the brain to work together to make sense of the visual input. Speech and language skills typically are well developed before the process of learning to read begins (Liberman, 1974; Nathan et al., 2004; Paulson, Kelly, Jepson, van den Pol, Ashmore, Farrier, & Guilfoyle, 2004). When reading, the brain receives the visual word, transforms the print into a speech representation, references the lexicon, and then passes the meaning on to the next part of the brain for comprehension. Readers must relate the visual information to speech structures already encoded within the brain then convert the speech information to a meaningful word. As Nichols, Rupley, & Rickelman (2004) claim, readers "shift their attention away from the content of speech to the form of speech" (p. 60). Goswami (2002) simply says that phonological awareness is a consequence of how the brain processes language. Some researchers conclude that the brain maps the words into lexical neighborhoods based on the individual phonemes (i.e. sounds) that work together to create the word (Gombert, 1992; Goswami, 2002; Tumner & Nesdale, 1985; Wagner & Torgeson, 1987). The neighborhoods or groupings of words that are related can be dense or sparse. Denser neighborhoods have more words that are related by beginning, middle, or end phonemes. An example of a dense neighborhood may be words related to *mat*. *Mat* is related to the word *men* through the initial phoneme and thus they can be mapped near each other in lexical neighborhoods. *Mat* is also related to *bag* since they have the same medial phoneme. *Mat* and *lit* are in close neighborhoods since they share a final phoneme. *Men, bag*, and *lit* are part of a dense lexical neighborhood because they all share characteristics with the word *mat*. Many other words can be related to these examples. Therefore, there is more demand for that area of the brain to organize the segments by sound in a fast and reliable fashion for easier and more efficient access (Tumner & Nesdale, 1985).

Many researchers in the area of reading acquisition agree that phonological awareness (sometimes called phonemic awareness) is a skill that is beneficial to the beginning reader (Anthony, Lonigan, Burgess, Driscoll, Phillips & Cantor, 2002; Cooper, Roth, Speece, & Schatschneider, 2002; Paul, 2001). It is important to clarify the differences between phonemic awareness and phonological awareness. Some literature uses these terms interchangeably. For the purposes of this paper, I will adopt the broad definition outlined in Anthony & Lonigan (2004) that phonological awareness encompasses the skills involving manipulation and judgment of any word structure. The definition of phonemic awareness used in this paper is the strictest used by Anthony & Lonigan (2004) as a "conscious reflection on abstract representations of speech" (p. 51).

Our study examined phonological awareness using onset detection and rime identification. The onset is the initial consonant of the word. Rime is the vowel and any remaining elements of the syllable. Both of these definitions are adopted from Treiman & Weatherston (1991). The research is conflicting about what the best predictor of reading is, how it should be measured, and whether the processes used are fundamentally different or the same (Anthony & Lonigan, 2004; Carroll, Snowling, Hulme, & Stevenson, 2003). Bryant even wrote an entire article on the conflicts amongst researchers in this area (2002). In agreement with Bryant, the importance behind literacy research is to discover how the processes work together to produce the outcome of a fluent reader. Developmental approaches such as this appear to be most appropriate for the purposes of this paper. We incorporated the two most basic phonological skills of detection and sensitivity. Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh & Shanahan (2001) propose that one of the easiest phonological tasks is comparing initial sounds in words and identifying a picture based on the same sound which was one of the tasks our study utilized in measuring onset detection. Martin and Byrne (2002) cite research that found sensitivity to rhyme and alliteration (onset) are developmental precursors to of phoneme detection and plays a considerable role in learning to read. Many researchers agree that when children are better at detecting and manipulating syllables, rhymes, or phonemes, they learn to read faster and more successfully (Bryant, MacLean, Bradley, & Crossland, 1990; Burgess, 2002; Goswami, 2002; Paul, 2001). Those young children who have not learned the skills of phonological detection and sensitivity at the time formal literacy instruction begins can have difficulty in learning to read (Cooper et al., 2002; Miller, 2004).

The developmental phonological awareness point of view suggest that it is appropriate and natural that children are first aware of the larger units, or grains, in words like syllables before the smaller grains such as phonemes (Burgess, 2002; Bryant, 2002; Martin & Byrne, 2002; Treiman & Weatherston, 1992). Children are acquiring phonological awareness when they begin to realize that words do not just have meanings but structures that can be manipulated (Paulson et al., 2004). The most basic level in phonological awareness is segmenting initial sounds in words (Ehri et al., 2001). Metalinguistic abilities are in the beginning stages when children consciously realize that these units make up the words they use. In data reported by Gambell (2004), phonological awareness measured in kindergarten predicted metalinguistic skills in first and second grades when children are learning how to read for information. Phonological awareness in this sense is essentially children being able to think about the ways words are put together in their native language. Though phonological awareness begins with larger grains in the prereading phase, Goswami (2002) cautions that knowledge and skills with all sizes of grain are necessary for becoming a successful reader.

Rhyming is an important phonological skill that is typically acquired early in the literacy process (Ehri et al., 2001; Paul, 2001). Playing with language and speech is enjoyable to children in the form of books, games, and chants that rhyme. Nichols, Rupley, & Rickelman (2004) cites Yopp (1995) "the most accessible, practical, and useful vehicles to enhance students' sensitivity to the phonological basis of their language are children's books that deal playfully with speech sounds through rhyme, alliteration [onset], assonance, or other phoneme manipulation" (p. 538). Fun with oral language has a very important role in typical children's language development (Bryant et al., 1990; Martin & Byrne, 2002). Beginning phonological awareness is shown when children begin to enjoy activities with alliteration and rhyming (Paul, 2001). Rhyme is so important to reading that Martin & Byrne (2002) suggest that it may be intuitive that rhyme is taught first since it is the easiest aspect of speech organization but caution that because rhyme develops first that it does not indicate that it is the direct cause of other areas of phonological awareness. They go on to say that their results found that rhyme detection has a direct path to reading acquisition and indirect path through phonological awareness. Children reach ceiling on tests of rhyme before segment detection such as onset (Martin & Byrne, 2002). Though it may be intuitive, special instruction is still needed in school and in the home. At-risk readers, or readers who are deficient in language, will benefit from special instruction. When the students feel successful, they can be more receptive to learning new skills and taking more risks in their language. Teaching the easiest of skills first, like rhyming, can help children feel more successful and be more willing to move on to more difficult phonological tasks like onset.

Many facets of language are part of the reading process. The levels of the importance of the skills are debated but, nonetheless, they are ultimately necessary. Repeatedly, language skills and phonological awareness are emphasized as being critical in learning to read. Anthony et al. (2002) define areas that are critically important to reading acquisition to be phonological processing abilities, print knowledge, and oral language. Nathan et al. (2004) found that early speech, language, and literacy skills show that preschool language ability is unique predictor of the awareness of phonological units. Poe, Burchinal, & Roberts (2004) state that "during initial acquisition of reading skills, language skills at entry to school provide the skills necessary to acquire phonological skills" (p. 329). Phonological awareness may be a significant factor in developing reading but other aspects of oral language may be equally as important (Gambell, 2004). Paulson et al. (2004) apply a critical age hypothesis to language. According to these researchers, this hypothesis is important to consider because there have been studies that conclude that children who experience difficulty acquiring language and who are able to develop language that is considered age-appropriate before the age of 60-66 months are less likely to experience difficulty in learning to read. This is particularly relevant to our study since the ages of the children who participated fall within or near this range. Our participants also probably experienced or are still experiencing some difficulty in acquiring language since they are all hearing impaired.

Language is not the only area in which impairment may affect children's abilities to learn to read. The production of speech can be extremely difficult for some children. Some of these children have been studied during their quest for literacy. Findings such as those by Liberman in 1974 propose that children need to have awareness of word units in speech to learn to read alphabetic script. Nathan et al. (2004) designed their study around the language and speech issues related to reading. They examined the developmental relationships between different phonological processing abilities and speech/language abilities. These authors suggested that there is an indication that children with trouble in both speech and language have difficulties in the development of phonological awareness, reading and spelling skills. Bishop and Adams (1990) propose a critical age hypothesis that suggests that children whose speech problems persist past the age where they need phonological skills for reading are at a higher risk for trouble in learning to read.

What if a child does not acquire language normally? What if the child cannot accurately, reliably, and consistently hear or produce the phonemes that build words? This child may not learn to read in the easiest and most efficient fashion according to many researchers. Children who have difficulty learning oral language are at significant risk for having trouble in reading to read (Paulson et al., 2004). Nathan et al. (2004) agree and cite research that children with language and speech difficulties are at risk for problems with reading. Children in their study who had language as well as speech troubles typically had greater speech difficulties than children who had speech trouble alone. Children with hearing impairments range in their oral language and speech abilities. It is more common than not that those children who are deaf/hard of hearing have language and speech delays (if not additional impairments) as well as the degradation of a sense. Individuals with profound hearing losses are better readers if they use a phonological memory strategy during reading (Miller, 2004). Impairments or delays in language can lead to delays and trouble with reading (Tye-Murray, 2004). According to Paul (2001), deaf/hard of hearing children are an at-risk group. Studies have repeatedly shown that this group of children plateau in their reading skills at around a fourth grade level while their typically hearing peers generally achieve much higher. Paul (2001) goes on to say that is important for children who are deaf/hard of hearing to be exposed to a language system that completely encodes oral English if they are not using an oral language communication approach.

There are a variety of reading instruction strategies that are frequently used in regular education classrooms that emphasize auditory skills (Rose, McAnally, & Quigley, 2004). These approaches can be difficult for children with an impaired auditory system. Children with hearing impairments often naturally depend on visual cues like speech reading to understand what a speaker is saying and, if they are not face to face with a speaker, they can miss some important linguistic elements of the conversation (Ratner, 2001). If reading instruction relies on auditory strategies and children who are deaf/hard of hearing cannot fully hear and understand, they can miss some very important elements of teaching. A multisensory approach where children use their residual hearing and any visual information from the speaker's face would appear to be more beneficial to children who need both of these inputs to gain missing elements of the auditory signal they are receiving (Paul, 2001). Paul (2001) further states that children with impaired hearing make similar types of reading errors and use similar strategies to children with normal hearing. He goes on to say that many children who are deaf/hard of hearing make more reading errors than their normally hearing peers "due in part to the perception of an incomplete or inadequate auditory signal" (p. 229). It is probably a great benefit for these children to be able to use their visual pathways to make sense of speech and better understand the phonological components of language (Ratner, 2001; Paul, 2001).

There has been little research focus on emergent literacy skills in the deaf/hard of hearing population (Rose et al., 2004). It is important that research examine prereading skills in children who are hearing impaired because language and reading are reciprocal and these children can benefit from having a visual representation of the language. Though children who are deaf/hard of hearing have had many life experiences before they begin to learn to read, their experiences often have not been tied to the language and vocabulary that accompanies the occurrences (Rose et al., 2004). If children with impaired hearing are deficit in language, which is the vital connection from print to knowledge, they cannot apply their prior experiences to text to glean information from the printed words (Rose et al., 2004). Children who have impaired hearing are typically delayed in their language and speech. When they receive and consistently use their first amplification device, prelingually deafened children begin more quickly acquiring the language skills that other typical children have been acquiring from birth. These children can still have impairments and/or atypical development in the areas of speech and language since they have been deprived of hearing spoken language in a normal manner (Gleason, 2001). Reading, for this group, can be vital to their academic success as well as a gateway for them to reliably receive information for every aspect of their lives (Rose et al., 2004).

Emergent literacy is an area that ought to be examined more fully so that children who are deaf/hard of hearing can begin the road to reading success as early as possible. Rose et al. (2004) recommend that every program that educates deaf/hard of hearing children should have a strong focus on developing literacy skills. These researchers list conditions from King & Quigley (1985) that they suggested are necessary for the child who is deaf/hard of hearing to learn to read. The list includes prereading abilities (world knowledge and experience, cognitive abilities, and linguistic skills) that are comparable to typically hearing children. As Ratner (2001) states, "mastery of reading and writing is inextricably linked to knowledge of the oral language system, a system to which the deaf child has impeded access" (p. 351).

Purpose

The purpose of this study was to examine children with hearing impairment who are oral language communicators and their basic phonological skills of identifying rimes and detecting onsets. Miller (2004) cites Conrad's (1979) findings with children who are hearing impaired and states, "the inability to use a phonological strategy may have detrimental consequences for achieving literacy" (p. 980). Rime and onsets are basic phonological skills that have been shown to predict later success in reading. It is important that this be probed in children who are deaf/hard of hearing because reading and language are reciprocal skills. Children with a degraded auditory system have been shown to lag behind their peers in language, speech, and reading. We sought an answer to the questions: can young children who are at the pre-literacy stage and who also are deaf/hard of hearing demonstrate phonological awareness through identifying rime and detecting onset of words? Does the addition of the visual modality have an effect on their onset detection or rime identification? If children who are deaf/hard of hearing can acquire the skills necessary to learn to read earlier as indicated by their phonological awareness, they may be able to start formal reading instruction and begin reaping the language benefits of all that reading can offer. Because reading can give children access to more language in a variety of contexts, young children who are deaf/hard of hearing who are reading may have an advantage in language acquisition over those who are not yet reading.

Methods

This study examined identification (or sensitivity) measures in onset and rime not production measures. Rhyme production is poor measure of sensitivity according to Wagner & Torgeson (1987) since producing a series of words that rhyme is a higher level skill requiring the child to access different areas of the lexicon which require the brain to go through phonological recoding (Wagner & Torgeson, 1987). In producing rhymes, children are required to expressively state the rhyming words, which may be difficult for some young children who are deaf/hard of hearing since their speech, and language skills may not be at a level where they can be intelligible (Tye-Murray, 2004) or possess the expressive vocabulary to retrieve a rhyming word. These difficulties can range from lack of appropriate or obligatory vocabulary to complete the task to speech or production trouble. These identification tasks were chosen to obtain data that included children capable of detecting rhyming words but not necessarily of producing them. Both rime and onset skills reflect a child's basic phonological awareness and might possibly serve as an indicator for reading readiness.

Participants

The 16 children participating in this study were residents of one of two midwestern states. The individual data for them is shown in Table 1. Their ages fell between 4 years, 10 months and 6 years, 11 months with a mean age of 5 years, 9 months. There were 7 male and 9 female participants. The ethnicities were reported by the parents of the participants with 11 children identified as Caucasian, 4 as African American, and 1 as Latino. The range of their unaided hearing losses showed the whole spectrum from mild to profound but their Speech Detection Thresholds (SDT) range from 0-50 dBHL. SDTs are usually measured while the respondent is wearing his/her amplification device. There were 6 children who used a cochlear implant, 8 who wore hearing aids, one child who utilized both, and one child who did not use any amplification devices. All had normal or corrected normal vision when screened during one of the sessions. At the time of testing, none of the children had been enrolled in first grade and all were non-readers.

Table 1 Participant Information.

Age (months)	Gender	Ethnicity	Amplification Device	SDT (dBHL)
58	F	C	CI	15
59	F	AA	CI	30
60	F	AA	HA	40
61	M	AA	HA	20
62	M	L	HA	35
63	F	C	CI	50
66	M	C	HA	30
67	M	AA	CI	15
70	F	C	HA	0
72	F	C	HA	5
75	F	AA	HA	25
79	M	C	CI	40
80	M	C	CI/HA	35
81	F	C	N/A	0
81	F	C	HA	10
83	M	C	CI	40

F→female, M→male; C→Caucasian, AA→African American, L→Latino; CI→cochlear implant, HA→hearing aids

Materials

The participants were seated in a sound treated booth with a test administrator. For the tasks administered in the auditory-visual condition, the participants watched a 19-inch computer monitor. The screen was framed with red poster board to prevent them from being distracted by the non-essential test material on the computer screen. Children sat approximately 18 inches from the computer monitor. The test administrator held up an 8 ½ by 11-inch piece of laminated tag board in front of the child while they faced the monitor and/or loudspeaker. The page was divided into fourths with each section containing colored drawings for the child to associate with the word being presented. The loudspeaker was mounted about 18 inches below the ceiling in the far corner of the booth.

Procedure

The onset detection task was to select the picture representing a word that began with the same phoneme as the stimulus word. Each child was tested individually. The participants were seated in a sound treated booth. The stimulus was presented over a loudspeaker at approximately 70 dBHL simultaneously with a video of a male child talker saying the word. During another test session, the child was presented the same list of words with only an auditory stimulus. A test administrator held a picture card in front of the child with four pictures of equal size as the children were presented with the stimulus. Before each session, the child was familiarized with the pictures on each card. The words the pictures represented varied by: consonant correct place, correct voicing; consonant correct place, incorrect voicing; consonant incorrect place, correct voicing. The order of the cards 1-10 or 10-1 was randomized, as was the condition in which the task was given. For example, if the child received the auditory condition first, then he or she received the task in the auditory visual condition during the second session.

The test administrator introduced the task by showing a card with a picture of a strawberry and a pencil. The administrator told the child that *strawberry* starts with straw. The child was then asked to point to the picture that starts with pen. The administrator reinforced the child's correct choice by saying, "Good! *Pencil* starts with pen." If the child did not understand

and required further instruction, the administrator provided other examples using the child's name or familiar objects. Once the child was ready to begin the task, the administrator asked the subject to watch and/or listen to a child male talker say a single syllable word on a computer monitor. The participant then pointed to his or her answer from a set of four pictures. If it was evident that the child did not understand the task during the administration, the administrator could continue explaining with each stimulus. If child then began to understand, the stimuli could be repeated from the beginning of the task. The responses were relayed by a number code to another tester outside the booth who recorded the responses into a computer database. The stimulus was repeated after the task had been completed if the child answered incorrectly on the first presentation.

The rime sensitivity task was to select the picture representing a word that rhymed with the stimulus word. Each child was tested individually. The subject sat in a sound treated booth. The stimulus was presented over a loudspeaker at approximately 70 dBHL simultaneously with a video of a male child talker saying the word. During another test session, the child was presented the same list of words with only an auditory stimulus. A test administrator held a picture card in front of the child with four pictures of equal size as the children were presented with the stimulus. Before each session, the child was familiarized with the pictures on each card. The words the pictures represented varied by: correct vowel, correct consonant; incorrect vowel, correct consonant; correct vowel, incorrect consonant; incorrect vowel, incorrect consonant. The order of the cards 1-10 or 10-1 was randomized, as was the condition in which the task was given.

To introduce the task, the test administrator used the children's book Hop on Pop by Dr. Seuss. The administrator explained that words like *pop* and *mop* rhyme or sound the same.

Other examples were provided using the text. The administrator asked the child to produce a rhyme with a given word to check the child's understanding. When the child understood the task, he or she was asked to watch and/or listen to a child male talker say a single syllable word on a computer monitor. The child then chose from a set of four pictures. The stimulus was repeated after the task had been completed if the child answered incorrectly on the first presentation. The responses were relayed by numeric code to another tester outside the booth who recorded the responses into a computer database.

Results

For the tests of rime and onset, a correct score was if children (n=16) correctly identified the picture that rhymed with or started with the correct phoneme. Onset was considered the independent variable since, as stated previously, rhyming is usually the first phonological skill to develop. We measured phonological awareness by using the easier of the tasks, rime identification, to predict onset detection. Table 2 shows the mean numbers of correct responses in the auditory (A) and auditory-visual (AV) conditions for both sets of tasks. The mean scores of the AV rime and AV onset were identical though the spread of the scores was different as shown in Table 2. This may indicate that, in children with impaired hearing, these skills are developing at the same time. The strongest correlation found in the analysis was between A rime and A onset with p=.0014. The correlation from Fisher's r to z was .709.

Table 2 Statistical Analysis

Correlation Matrix

	A Onset%	AV Onset%	A Rime%	AV Rime%	SDT	Age Mos
A Onset%	1.000	.392	.709	.295	-.251	.505
AV Onset%	.392	1.000	.189	.474	.131	.331
A Rime%	.709	.189	1.000	.340	-.179	.441
AV Rime%	.295	.474	.340	1.000	.026	.381
SDT	-.251	.131	-.179	.026	1.000	-.161
Age Mos	.505	.331	.441	.381	-.161	1.000

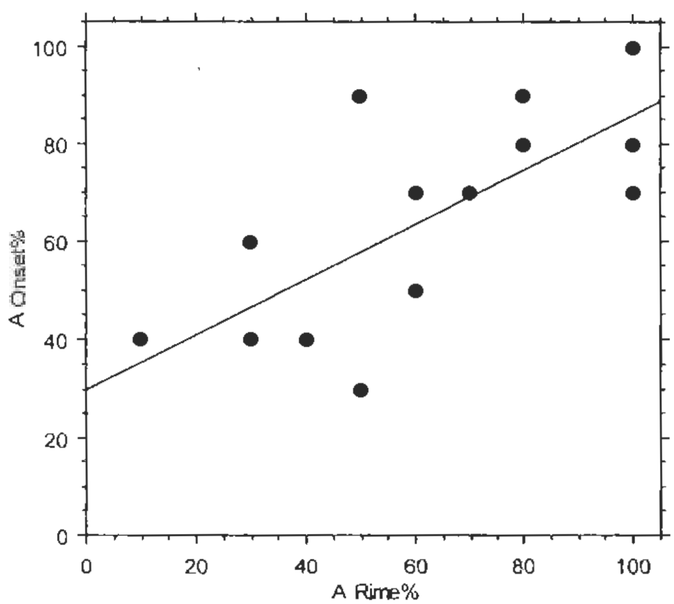
16 observations were used in this computation.

Fisher's r to z

	Correlation	P-Value
A Onset%, AV Onset%	.392	.1353
A Onset%, A Rime%	.709	.0014
A Onset%, AV Rime%	.295	.2733
A Onset%, SDT	-.251	.3549
A Onset%, Age Mos	.505	.0450
AV Onset%, A Rime%	.189	.4898
AV Onset%, AV Rime%	.474	.0629
AV Onset%, SDT	.131	.6337
AV Onset%, Age Mos	.331	.2153
A Rime%, AV Rime%	.340	.2018
A Rime%, SDT	-.179	.5153
A Rime%, Age Mos	.441	.0879
AV Rime%, SDT	.026	.9248
AV Rime%, Age Mos	.381	.1483
SDT, Age Mos	-.161	.5586

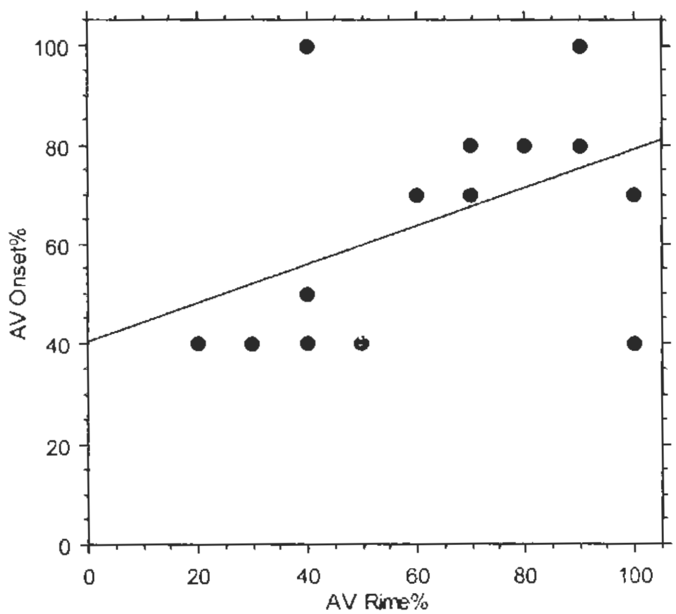
16 observations were used in this computation.

Figure 1.1 Auditory rime identification strongly correlates with auditory onset detection.



We visually identified two outliers when comparing AV rime and AV onset. With these outliers removed from the data (n=14), we found that A rime and A onset were more highly correlated with p=.0004 and a correlation of .786. Therefore, we can say that with these two data sets removed, rime more significantly predicts onset as we expected originally. Rime identification can be a predictor of onset detection in the auditory condition, which indicates that children could be maturing in their phonological awareness skills since onset is suggested to be a more difficult task.

Figure 1.2 Identifying rime and detecting onset in the auditory visual condition.



In answering the second question, we did not see A rime predicting AV rime (p=.2018) in the full sample or (p=.3298) in the reduced sample. This was also true of A onset predicting AV onset (p=.1353) in the full sample or (p=.1521) in the reduced sample. We originally expected to see that scores from the auditory condition were predictive of scores in the auditory-visual condition since, for children with hearing impairments, the auditory alone modality is naturally more difficult for reasons discussed earlier.

Figure 1.3 Rime identification scores in the auditory alone condition did not predict rime identification scores in the auditory visual condition.

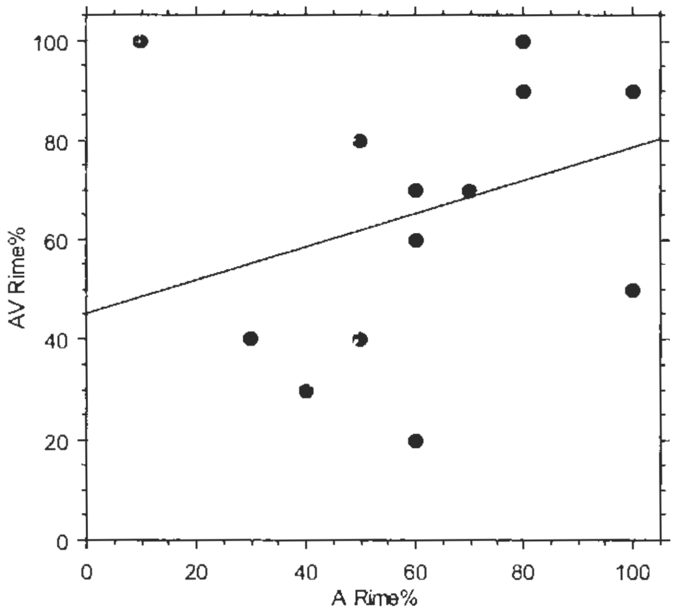
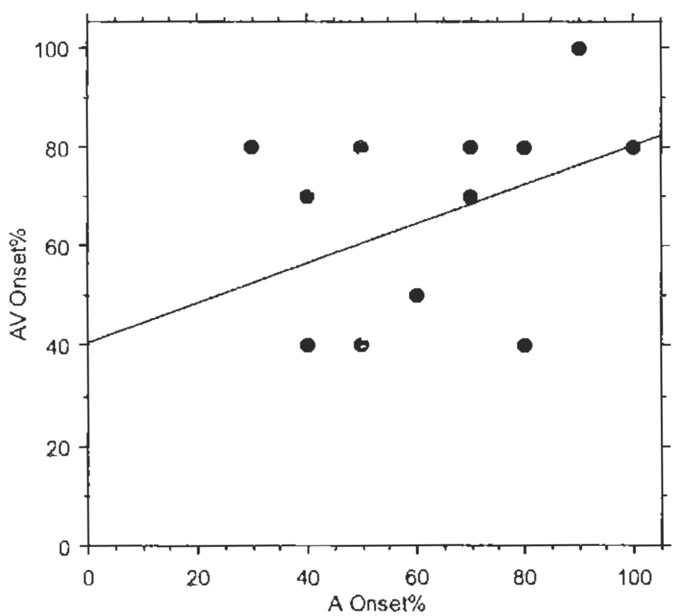


Figure 1.4 Onset detection scores in the auditory alone condition did not predict onset detection scores in the auditory visual condition.



When comparing the conditions in which the stimuli were presented, the full data set analysis found that AV rime and AV onset were only somewhat related with a correlation value of .474 and p=.0629. This data is displayed in Table 2 along with the revised graph. We ran the statistical analysis with the two outliers removed and found that the tasks in the AV condition were more related with a value of .871 and p<.0001. The identification of onset was related to age in months with p= .0450 in the full sample.

Table 3 Outliers removed.

Correlation Matrix
Row exclusion: DataCT (imported)

	A Onset%	AV Onset%	A Rime%	AV Rime%	Age Mos
A Onset%	1.000	.407	.786	.368	.450
AV Onset%	.407	1.000	.345	.871	.447
A Rime%	.786	.345	1.000	.286	.445
AV Rime%	.368	.871	.286	1.000	.376
Age Mos	.450	.447	.445	.376	1.000

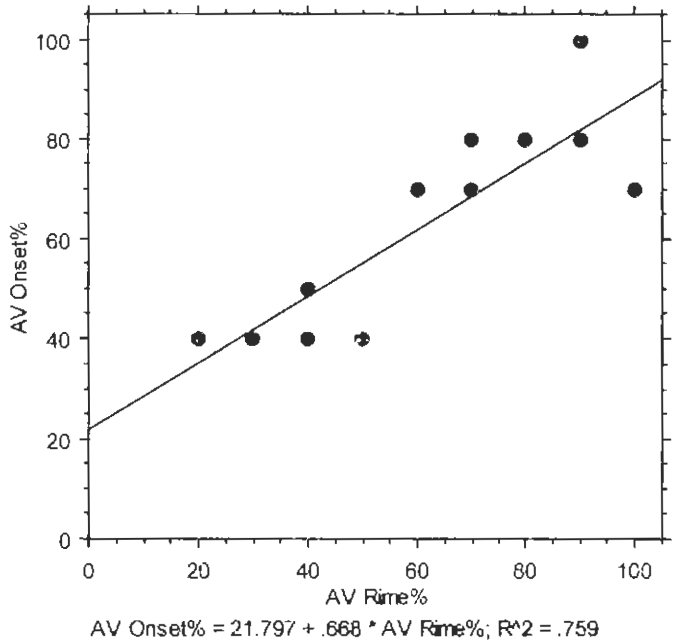
14 observations were used in this computation.

Fisher's r to z
Row exclusion: DataCT (imported)

	Correlation	P-Value
A Onset%, AV Onset%	.407	.1521
A Onset%, A Rime%	.786	.0004
A Onset%, AV Rime%	.368	.2003
A Onset%, Age Mos	.450	.1076
AV Onset%, A Rime%	.345	.2326
AV Onset%, AV Rime%	.871	<.0001
AV Onset%, Age Mos	.447	.1104
A Rime%, AV Rime%	.286	.3298
A Rime%, Age Mos	.445	.1123
AV Rime%, Age Mos	.376	.1898

14 observations were used in this computation.

Figure 2.1 Outliers removed.



Discussion

This study is unique in the quality that it tests its participants who are deaf/hard of hearing in rime and onset tasks. The children who are hearing impaired and participated in this study possessed the phonological skills of identifying rimes and detecting onsets. As expected, rime and onset skills were highly related in the full sample and even more so in the smaller sample. If the children were able to identify a drawing representing a word that rhymed with the stimulus, they were capable of choosing a picture that represented a word that began with the same onset as the stimulus. This supports claims from other authors (see introduction) that the phonological skill of rime identification is a predictor of onset skills. As suggested by Paul (2001), the children who were part of this study show similar patterns to their typically hearing peers in their development of phonological skills. This may indicate that though children who are deaf/hard of hearing often have atypical language and speech development and are still in the process of mastering spoken language they can still develop phonological skills that are indicators of reading readiness.

Though other authors propose that individuals with hearing impairments benefit from sensory input through both the auditory and visual pathways, our results do not show any significant effect by the sensory input. The children who were participants in this study were all primarily users of spoken English. It is possible that this had an effect on the results since the participants currently are attending or previously may have attended preschool programs that put an emphasis on auditory training rather than a multisensory approach allowing them to use their auditory and visual pathways simultaneously. With a larger sample of children who are deaf/hard of hearing, these results may show alternate findings.

The effect of the children's hearing losses as indicated by the SDT had no significant effect on the results. With improvements in hearing aid and cochlear implant technology and the amount of auditory training received in programs with a spoken language emphasis, this result may not be surprising to a number of professionals knowledge of in this area. The cochlear implant can bring some children's hearing losses from the severe and profound ranges up to more moderate levels (Ratner, 2001; Paul, 2001). Tye-Murray (2004) cites data (Spencer, Tomblin, & Gantz, 1997) suggesting that children who use cochlear implants can "develop superior reading skills" (p. 650).

It is possible that, due to universal newborn hearing screening leading to earlier diagnosis and amplification, children with hearing impairments are getting the services they need at an younger age. Therefore, they are more quickly catching up to the language and speech skills demonstrated by their typically hearing peers. With appropriate services, these children are able to begin the process of acquiring language earlier with identification of the hearing loss at a younger age. This is important for reading skills because, as discussed previously in this paper, language and reading are reciprocal skills. As one area grows and increases in competence, then ideally so will the other.

Of course, there are many other complexities to reading than just decoding the words on the page. Especially with children who are hearing impaired and still acquiring proficiency in spoken language, they are learning to read a language that they have not yet mastered. Vocabulary may have no meaning to them if they have not had that experience in life or they may not transfer the word in situations that are more complex than they are linguistically ready to understand. Comprehension is a vast area of literacy that this study does not examine. However, if the children cannot decode the word, how will they be able to understand it?

Study Limitations

The sample size in this study was admittedly very small. It is preliminary data from a much larger longitudinal study examining many more facets of hearing-impaired children's language processing. At the conclusion of this study, many more children who are deaf/hard of hearing will have been evaluated and their results added to the configuration of data. The children who participated are also primarily from the same suburban area in the Midwestern United States so, though the demographic information is varied by socioeconomic status, a geographic diversity is lacking.

Implications and conclusions

Basic language skills are the primary focus of oral preschool programs for children who are deaf/hard of hearing. Their day is centered on structured language activities designed to strengthen their oral language skills. Their attention is constantly drawn to the finer points of speech and language through the lessons. Can this attention to the structure of oral language help the children become more aware of the units that make up words in oral language? Will children who are deaf/hard of hearing make the transfer from oral language or manually coded English to the written word? Incorporating prereading skills such as phonological awareness can give children who are deaf/hard of hearing an advantage when it comes time for them to begin formal reading instruction. Further literacy and language research should be conducted in these crucial areas. It would be beneficial for longitudinal studies to look at how and when young children with hearing impairments learn to read and if rime and onset skills are accurate predictors of reading success for this population.

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